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White Pine Root Rot at the Chittenden Nursery

The Chittenden Nursery was established by the U.S. Forest Service at Wellston, Mich., in 1934. During the 3 years following establishment, seedling production was good, but in 1937 and 1938 mortality began occurring in white pine (*Pinus strobus* L.) seedling and transplant beds. Seedbed losses reached 59 percent in 1939. These losss were at first attributed to white grubs (*Phyllophaga* sp.), but as losses continued, drought and acid injury were suspected. By 1944, however, it was decided that the white pine were being killed by root rot organisms.

Beginning in 1945, various attempts were made to determine the cause of this root rot. Fungus isolations from soil and from infected seedlings were inconclusive. Eleven species of nematodes were isolated but, although five were plant parasites, they were not considered abundant enough to have caused the damage. Tests in which nine different minor soil elements were applied to the beds showed no reduction of losses. Addition of organic matter was likewise ineffective.

A method of controlling the root rot was found as a result of a series of tests with various chemicals. The soil sterilant, methyl bromide, gave the best control (Anderson et al. 1956).[1] It also reduced weeding costs and stimulated seedling vigor. For these reasons, treatment with methyl bromide has been adopted as a standard nursery practice at the Chittenden Nursery.

Investigations have been continued to learn the exact cause of the root rot. Riffle and Strong (1960) conducted experiments with fungi isolated from the nursery. They reported that various species of *Fusarium* were re-isolated from 50 to 60 percent of their diseased experimental seedlings.

This paper reports the finding of *Cylindrocladium scoparium* Morg. in the Chittenden Nursery and the results of some inoculation experiments with isolates of this fungus. Two isolates of *Rhizoctonia* sp. obtained from this nursery were also used in the experiments.

During the summer of 1962, isolations were made from some of the few diseased white pine seedlings that can still be found in the nursery. Approximately 1,200 root pieces, ½ to 1 cm. in length, were plated on 2-percent malt agar containing 200 p.p.m. streptomycin sulfate. The root pieces were washed in running water for 1 hour, placed in a 1-percent solution of sodium hypochlorite for 1 minute, washed twice in sterile distilled water, and then plated on the malt agar medium. *Rhizoctonia* was isolated from several of these root sections, but *Cylindrocladium* was not recovered.

Cylindrocladium was recovered from Vernal alfalfa, *Medicago sativa* L., grown in soil taken from 2-1 and 2-2 white pine transplant beds

[1] *Names and dates in parentheses refer to literature cited at end of Note.*

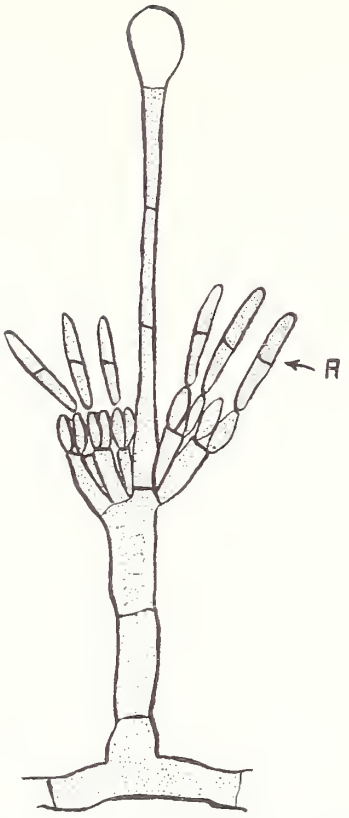

FIGURE 1 — Diagramatic sketch of *C. scoparium* conidial apparatus. Drawn approximately to scale. Conidia (A) are approximately 50 microns long.

(Bugbee 1962). Seedlings grown in this soil damped off soon after emergence. Under moist conditions the fungus sporulated on the dead tissue and the characteristic conidial apparatus of this fungus could be recognized, using a 10x hand lens (fig. 1). When sections of these diseased seedlings were placed on malt agar, *Cylindrocladium* grew out onto the medium. It produced characteristic reddish-brown microsclerotia and a mycelium having concentric zones and radial striations.

Inoculation tests were conducted with inoculum prepared by growing isolates of *Rhizoctonia* and *Cylindrocladium* on sterile mixtures of 10-percent cornmeal and soil for 3 weeks. This inoculum was mixed 1:25 with steamed soil. Dormant 2-0 seedlings of black spruce (*Picea mariana* (Mill.) B.S.P.), red pine (*Pinus resinosa* (Ait.)), and white pine were then potted in this inoculated soil. Thirty-six trees of each species were used.

After 8 weeks all of the trees planted in soil that had been inoculated with *Cylindrocladium* were dead. Most of those growing in soil that had been inoculated with *Rhizoctonia* and those growing in uninoculated soil were still healthy after 90 days. The one check seedling and the three seedlings growing in soil inoculated with *Rhizoctonia* that did die may have been damaged in transplanting.

Re-isolation tests were made from roots of the seedlings that died after being transplanted in soil inoculated with *Cylindrocladium* and from apparently healthy roots of seedlings transplanted in soil inoculated with *Rhizoctonia*. For the *Cylindrocladium* test, 100 root pieces from each tree species were placed in petri plates containing 2-percent malt agar. For the *Rhizoctonia* test, 76 root pieces were similarly treated. Three weeks later the percent of recovery of the two species of fungus was as follows:

	Cylindrocladium	*Rhizoctonia*
Black spruce	65	1.0
Red pine	41	4.0
White pine	13	2.5

Discussion

A serious root rot of pine and spruce in Lake States nurseries is caused by *Cylindrocladium scoparium*. Losses range from 10 to 20 percent to more than 90 percent. The fungus has been isolated from various conifer species at six nurseries in Minnesota, six in Wisconsin, and two in Michigan. However, attempts to isolate the fungus directly from diseased seedlings grown at the Chittenden Nursery over a 3-year period have been unsuccessful.

In the experiments reported in this paper, *Cylindrocladium scoparium* was isolated from Chittenden Nursery soil using the alfalfa technique. Three species of seedlings planted in soil inoculated with pure cultures of the fungus were killed within 8 weeks. Re-isolation from these dead seedlings yielded *Cylindrocladium* from 65 percent of the black spruce, 41 percent of the red pine, but only 13 percent of the white pine. The low recovery of *Cylindrocladium* from white pine may explain why previous workers have not isolated the fungus at the Chittenden Nursery.

Riffle and Strong (1960) did not indicate that *Cylindrocladium* was recovered in their study but did report that 36 percent of the fungi they isolated from the Chittenden Nursery failed to sporulate on acidified potato dextrose agar. It is possible that some of these fungi were *Cylindrocladium scoparium* because none of the isolates from 15 conifer nurseries the authors have worked with has sporulated on acidified potato dextrose or malt agar. They all sporulated, however, when grown on Czapeks medium (Anderson et al. 1962).

The root rot situation at the Chittenden Nursery is apparently unique among Lake States nurseries. At this Nursery only white pine were infected. In other nurseries where *Cylindrocladium* has been isolated, several conifer species have suffered root rot damage. In recent greenhouse experiments, the *Cylindrocladium* fungus was found to be parasitic on 12 of 13 conifer species. Northern white-cedar, *Thuja occidentalis* L., was the only resistant species (Anderson et al. 1962). More research is needed to determine the ecological conditions which apparently limit *Cylindrocladium* root rot to white pine at the Chittenden Nursery.

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